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(54) Title of the Invention: **Metal Die Clearance Measurement Method**

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Specification

1. Title of the Invention

Metal Die Clearance Measurement Method

2. Claims

(1) A metal die clearance measurement method, wherein pressure is applied to a workpiece by the metal die, a plurality of holes are bored along nearly the entire surface of the workpiece, a pad is deformed and inserted into the holes of the workpiece by the pressure so that some of the pad protrudes from the holes, pressure is applied to the workpiece by the metal die, the amount of pad deformation or protrusion due to the pressure is determined, and the metal die clearance is measured based on the calculation.

3. Detailed Description of the Invention

(Industrial Field of Application)

[01] The present invention relates to a metal die clearance measurement method and, more specifically, to a metal die clearance measurement method ideal for the adjustment of metal dies.

(Prior Art)

[02] Clearance adjustments are often performed during the manufacture of metal dies such as press dies. During the metal die clearance adjustment, a clearance sheet is used to measure the metal die clearance. However, large

clearances and the clearances between metal dies cannot be measured accurately using a clearance sheet. For this reason, paint is applied to the surface of metal dies before bringing them together. The operator often has to shave off the paint where it has come off due to metal die interference.

(Problem Solved by the Invention)

[03] Unfortunately, it is difficult to obtain uniform metal die surface clearance using a clearance adjustment method based on the application of paint to metal die surfaces. The operator also has to repeatedly shave off the paint, which increases the number of steps in the process. If the operator shaves too much, moreover, the clearance may be adversely affected.

[04] In light of this situation, the purpose of the present invention is to provide a metal die clearance measurement method in which clearance adjustments are quick and accurate and in which the resulting metal die surface clearance is uniform.

(Means of Solving the Problem)

[05] In order to achieve this purpose, the present invention, as shown in FIG 1, is a metal die clearance measurement method, wherein pressure is applied to a workpiece by the metal die (Step 100), a plurality of holes are bored along nearly the entire surface of the workpiece (Step 102), a pad is deformed and inserted into the holes of the workpiece by the pressure so that some of the pad

protrudes from the holes (Step 104), pressure is applied to the workpiece by the metal die (Step 106), the amount of pad deformation or protrusion due to the pressure is determined (Step 108), and the metal die clearance is measured based on the calculation (Step 110).

(Operation)

[06] Pressure is applied to a workpiece by the metal die, a plurality of holes are bored along nearly the entire surface of the workpiece, a pad is deformed and inserted into the holes of the workpiece by the pressure so that some of the pad protrudes from the holes, pressure is applied to the workpiece by the metal die, the amount of pad deformation or protrusion due to the pressure is determined, and the metal die clearance is measured based on the calculation.

(Working Examples)

[07] The following is a detailed explanation of working examples of the present invention with reference to the drawings.

[08] When a metal die clearance measurement is performed, as shown in FIG 2, pressure is applied to a workpiece 10 using the metal die to be measured, and a plurality of holes 12 are bored into the workpiece 10 using a punching press. Next, as shown in FIG 3, a pad 14 is pushed through the holes 12 in the workpiece 10 opened by the punching press so that some of the pad 14 protrudes from the holes 12 in the workpiece 10.

[09] Then, as shown in FIG 4, the workpiece 10 with the inserted pad 14 is placed on top of a lower die 16, and pressure is applied to the workpiece 10 by the lower die 16 and the upper die 18. The pad 14 is embedded inside the holes 12 at clearance zero, as shown in FIG 5, and some of the pad 14 protrudes from the holes 12 at maximum clearance, as shown in FIG 6. The amount of protrusion in the pad 14 is then measured. By shaving the wall surface of the upper die 18 based on this measurement, the clearance of the upper die 18 can be reduced to zero.

[10] The holes can be bored into the workpiece 10 before press molding. However, if the holes are bored into the workpiece 10 before press molding, the hole diameters may become deformed when the material of the workpiece 10 is stretched during press molding. If the holes are bored into the workpiece 10 using a punching press after press molding, the distance between the holes 12 can be reduced. Because there is no stretching of the material during the press molding, more accurate clearance measurements can also be obtained. If the holes are bored into the workpiece 10 before press molding, the distance between the holes 12 should be $L \geq 10d$ and the diameter of the holes should be $d \leq 5t$ so that cracks do not develop in the workpiece 10 due to stretching during the press molding.

[11] During the press molding, the pressure distribution may cause slight discrepancies in the clearance measurement. If the amount of molding (stroke panel) is adjusted gradually using a workpiece 10 in which the inserted pad 14 has some give, the variations in clearance with each molding adjustment can be determined from the measurements.

[12] In this working example, the pad 14 is inserted into the holes 12. However, clearance measurements can be obtained even when the pad 20 is mounted in the holes 12 as shown in FIG 7 through FIG 9.

[13] This pad 20 consists of a round base 20A and cylindrical plugs 20B. Tabs 20C are formed at 120° intervals on the outer circumferential surface of the base 20A. Because the tabs 20C apply pressure to the wall surface of the holes 12, the pad 20 remains secure inside the holes 12 as the top of the plugs 12B protrude from the holes 12. The relationship between the thickness t_1 of the base 20A and the thickness t of the workpiece 10 is $t_1 \leq 1/2\ t$.

[14] When this pad 20 is mounted inside the holes 12 of the workpiece 10 and pressure is applied to the workpiece 10 by the lower die 16 and the upper die 18 as shown in FIG 10, the pad 20 becomes deformed by the pressure from the upper die 18 at a clearance near zero, and the plugs 20B become embedded inside the holes 12. When the pad 20 is at maximum clearance, the plugs 20b only become slightly deformed. By determining the amount of deformation in the

pad 20 and shaving the wall surface of the upper die 18 based on the amount of deformation, the clearance of the upper die 18 can be made uniform.

[15] As in the case of the previous working example, the holes in this working example can be bored into the workpiece 10 before press molding. However, if the holes are bored into the workpiece 10 before press molding, the hole diameters may become deformed when the material of the workpiece 10 is stretched during press molding. If the holes are bored into the workpiece using a punching press after press molding, the distance between the holes 12 can be reduced. Because there is no stretching of the material during the press molding, more accurate clearance measurements can also be obtained. If the holes are bored into the workpiece 10 before press molding, the distance between the holes 12 should be $L \geq 10d$ and the diameter of the holes should be $d \leq 5t$ so that cracks do not develop in the workpiece due to stretching during the press molding.

[16] The pad 20 should be made of a soft metal or plastic that does not damage the metal dies during press molding and does not return to its original shape without deformation once subjected to pressure. The pad 20 can have any shape so long as it does not cause the pad to rip and is able to enter the holes in the workpiece 10. The outer diameter of the base 20A should be somewhat larger than the diameter of the holes 12 so that the plugs do not fall out when inserted into the holes 12 in the workpiece 10.

(Effect of the Invention)

[17] In the present invention, as described above, a pad is deformed and inserted into the holes of the workpiece by the pressure so that some of the pad protrudes from the holes, pressure is applied to the workpiece by the metal die, the amount of pad deformation or protrusion due to the pressure is determined, and the metal die clearance is measured based on the calculation. As a result, the present invention provides a metal die clearance measurement method in which clearance adjustments are quick and accurate and in which the resulting metal die surface clearance is uniform.

4. Brief Explanation of the Drawings

FIG 1 is a flowchart used to explain the present invention. FIG 2 is a perspective view of the workpiece 10 in the present invention. FIG 3 is a simplified cross-sectional view of the pad 14 in the workpiece 10. FIG 4 is a diagram used to explain how pressure is applied to the workpiece 10 with pad 14 inserted. FIG 5 is a diagram used to explain zero clearance. FIG 6 is a diagram used to explain maximum clearance. FIG 7 is a perspective view of the pad in another working example of the present invention. FIG 8 is a bottom view of FIG 7. FIG 9 is a cross-sectional view of a pad 20 mounted in a workpiece 10. FIG 10 is a diagram used to explain how pressure is applied to the workpiece 10 with pad 20 inserted.

10 ... workpiece

12 ... hole

14, 20 ... pads

16 ... lower die

18 ... upper die

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[Text in Figures:]

FIG 1

START

100 ... Apply Pressure on Workpiece

102 ... Open Holes in Workpiece

104 ... Insert Pad in Holes

106 ... Apply Pressure on Workpiece

108 ... Calculate Amount of Distortion or Amount of Protrusion in Pad

110 ... Measure Metal Die Clearance Based on Calculations

END

FIG 4

Pressure

↓

FIG 10

Pressure

↓